

1 Docket No. GROU-012  
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4 **APPLICATION**

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8 **FOR UNITED STATES LETTERS PATENT**

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14 **SPECIFICATION**

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18 TO ALL WHOM IT MAY CONCERN:

19

20 BE IT KNOWN THAT I, **Ronald J. Hoffart**, a citizen of the United States,  
21 have invented a new and useful implement mounting system of which the following is  
22 a specification:

23

## Implement Pitch-Yaw System

## CROSS REFERENCE TO RELATED APPLICATIONS

Two other utility patent applications are being filed with the USPTO simultaneously with this application identified by Attorney Docket Numbers GROU-010 and GROU-011.

**STATEMENT REGARDING FEDERALLY  
SPONSORED RESEARCH OR DEVELOPMENT**

Not applicable to this application.

## BACKGROUND OF THE INVENTION

## Field of the Invention

The present invention relates generally to tractor implement mounting systems and more specifically it relates to an implement pitch-yaw system for effectively and efficiently controlling the pitch of an implement.

1    **Description of the Related Art**

2

3        Implement mounting structures have been in use for years. Conventional  
4        implement mounting structures, such as a front-end loader, allow for only lift and pitch  
5        movements. A bucket or other implement is pivotally attached to the distal ends of  
6        loader arms with at least one actuator directly connected between the loader arms and  
7        an upper portion of the bucket for facilitating the pitch movements of the bucket.  
8        However, these implement mounting structures are significantly limited in that they  
9        only provide lift and pitch movements for the implement.

10

11        Improvements have been made in the art so that additional movements such as  
12        roll and yaw may be accomplished for the implement utilizing additional actuators and  
13        complex structures. The roll movement is typically accomplished utilizing a pair of  
14        vertically orientated actuators attached to the mounting structure to roll the implement.  
15        The yaw movement is typically accomplished utilizing a pair of horizontally orientated  
16        actuators attached to the implement and the mounting structure.

17

18        U.S. Patent No. 6,059,048 illustrates an implement mounting arrangement  
19        having “all way” operability where a pair of horizontal actuators are utilized to control  
20        both the pitch and yaw of the implement. However, for the technology to work  
21        properly in controlling the horizontal actuators of the ‘048 patent, a complex hydraulic  
22        control system is required to effectively control the implement.

23

24        While these devices may be suitable for the particular purpose to which they  
25        address, they are not as suitable for effectively and efficiently controlling the pitch of  
26        an implement. Conventional implement mounting systems that provide “all way”  
27        operability are complex, bulky and difficult to utilize in an accurate manner.

28

29        In these respects, the implement pitch-yaw system according to the present

1 invention substantially departs from the conventional concepts and designs of the prior  
2 art, and in so doing provides an apparatus primarily developed for the purpose of  
3 effectively and efficiently controlling the pitch of an implement.

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## 2 BRIEF SUMMARY OF THE INVENTION

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4 In view of the foregoing disadvantages inherent in the known types of  
5 implement support systems now present in the prior art, the present invention provides  
6 a new implement pitch-yaw system construction wherein the same can be utilized for  
7 effectively and efficiently controlling the pitch of an implement.

8

9 The general purpose of the present invention, which will be described  
10 subsequently in greater detail, is to provide a new implement pitch-yaw system that has  
11 many of the advantages of the implement support systems mentioned heretofore and  
12 many novel features that result in a new implement pitch-yaw system which is not  
13 anticipated, rendered obvious, suggested, or even implied by any of the prior art  
14 implement support systems, either alone or in any combination thereof.

15

16 To attain this, the present invention generally comprises a first yaw actuator and  
17 a second yaw actuator attached between an implement pivotally attached to a support  
18 structure and a connecting member slidably attached to the support structure, and a  
19 pitch actuator attached between the connecting member and the support structure. The  
20 extension/retraction of the pitch actuator moves the yaw actuators accordingly thereby  
21 creating the desired pitch movement for the implement.

22

23 There has thus been outlined, rather broadly, the more important features of the  
24 invention in order that the detailed description thereof may be better understood, and  
25 in order that the present contribution to the art may be better appreciated. There are  
26 additional features of the invention that will be described hereinafter and that will form  
27 the subject matter of the claims appended hereto.

28

29 In this respect, before explaining at least one embodiment of the invention in

1 detail, it is to be understood that the invention is not limited in its application to the  
2 details of construction and to the arrangements of the components set forth in the  
3 following description or illustrated in the drawings. The invention is capable of other  
4 embodiments and of being practiced and carried out in various ways. Also, it is to be  
5 understood that the phraseology and terminology employed herein are for the purpose  
6 of the description and should not be regarded as limiting.

7

8 A primary object of the present invention is to provide an implement pitch-yaw  
9 system that will overcome the shortcomings of the prior art devices.

10

11 A second object is to provide an implement pitch-yaw system for effectively  
12 and efficiently controlling the pitch of an implement.

13

14 Another object is to provide an implement pitch-yaw system that provides a  
15 simple solution for providing both pitch and yaw to an implement.

16

17 An additional object is to provide an implement pitch-yaw system that  
18 accurately controls the pitch-yaw of an implement.

19

20 A further object is to provide an implement pitch-yaw system that does not  
21 require complex hydraulic control systems to control the movement of horizontal  
22 actuators.

23

24 Other objects and advantages of the present invention will become obvious to the  
25 reader and it is intended that these objects and advantages are within the scope of the  
26 present invention.

27

28 To the accomplishment of the above and related objects, this invention may be  
29 embodied in the form illustrated in the accompanying drawings, attention being called

1 to the fact, however, that the drawings are illustrative only, and that changes may be  
2 made in the specific construction illustrated and described within the scope of the  
3 appended claims.

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2                   **BRIEF DESCRIPTION OF THE DRAWINGS**

3

4           Various other objects, features and attendant advantages of the present  
5 invention will become fully appreciated as the same becomes better understood when  
6 considered in conjunction with the accompanying drawings, in which like reference  
7 characters designate the same or similar parts throughout the several views, and  
8 wherein:

9

10           FIG. 1 is an upper perspective view of the present invention.

11

12           FIG. 2 is a top view of the present invention with the implement pitch rearward.

13

14           FIG. 3 is a top view of the present invention with the implement pitch forward.

15

16           FIG. 4 is a side view of the present invention with the implement pitch  
17 rearward.

18

19           FIG. 5 is a side view of the present invention with the implement pitch forward.

20

21           FIG. 6 is a top view of the present invention with the implement pitch rearward  
22 with the yaw at an angle.

23

24           FIG. 7 is a top view of the present invention with the implement pitch rearward  
25 with the yaw at an angle.

26

27           FIG. 8 is a flowchart illustrating the overall functionality of the present  
28 invention.

1           FIG. 9 is a block diagram illustrating the hydraulic connections within the  
2, present invention.

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## 2 DETAILED DESCRIPTION OF THE INVENTION

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### 4 A. *Overview*

5       Turning now descriptively to the drawings, in which similar reference  
6 characters denote similar elements throughout the several views, FIGS. 1 through 9  
7 illustrate an implement pitch-yaw system 10, which comprises a first yaw actuator 70  
8 and a second yaw actuator 70 attached between an implement pivotally attached to a  
9 support structure 30 and a connecting member 62 slidably attached to the support  
10 structure 30, and a pitch actuator 60 attached between the connecting member 62 and  
11 the support structure 30. The extension/retraction of the pitch actuator 60 moves the  
12 yaw actuators accordingly thereby creating the desired pitch movement for the  
13 implement.

14

### 15 B. *Support Structure*

16       As shown in Figures 1 through 7 of the drawings, the support structure 30 is  
17 comprised of an elongate structure. Various other structures may be utilized to  
18 construct the support structure 30 other than shown in the drawings. The support  
19 structure 30 may be attached directly to a vehicle (e.g. tractor, etc.), to a frame  
20 structure or by other means.

21

22       A cuff structure 32 at the distal end of the support structure 30 may be utilized  
23 to attach the support structure 30 to a pivot joint such as but not limited to a ball-and-  
24 socket joint. A cross member 34 is preferably attached to the support structure 30 for  
25 receiving vertical actuators for allowing manipulation of the lift and roll of the  
26 implement structure 12.

27

1        As shown in Figures 1 through 7 of the drawings, the support structure 30  
2    preferably has a cavity for receiving the pitch actuator 60 within. However, the pitch  
3    actuator 60 may be positioned external of the support structure 30.

4

5    **C.    *Implement Structure***

6        The implement structure 12 is pivotally attached to the support structure 30 by  
7    at least one front joint 36 for preferably allowing both pitch and yaw movements to  
8    occur. The implement structure 12 may be any type of an implement such as but not  
9    limited to a blade, a plow, a bucket, a brush or other device. In addition, the  
10   implement structure 12 may be any type of an attachment structure for removably  
11   receiving an implement.1

12

13   **D.    *Connecting Member***

14       The connecting member 62 is slidably attached to the support structure 30 as  
15   shown in Figures 1 through 7 of the drawings. A slide structure 64 is preferably  
16   slidably positioned about the support structure 30 with the connecting member 62  
17   attached to the slide structure 64 as best shown in Figures 4 and 5 of the drawings.

18

19       As shown in Figures 6 and 7 of the drawings, the connecting member 62  
20   preferably has a winged structure. The first yaw actuator 70 and the second yaw  
21   actuator 70 are attached to opposing portions of the connecting member 62 as further  
22   shown in Figures 6 and 7 of the drawings. In addition, the connecting member 62  
23   preferably is centered along a longitudinal axis of the support structure 30 and the  
24   movement of the connecting member 62 preferably is parallel to the longitudinal axis  
25   of the support structure 30.

26

27   **E.    *Yaw Actuators***

28       As shown in Figures 1 through 7 of the drawings, a first yaw actuator 70 and a  
29   second yaw actuator 70 are attached between the implement structure 12 and the

1 connecting member **62**. The first yaw actuator **70** and the second actuator are for  
2 controlling the yaw position of the implement structure **12**.

3

4 **F. Pitch Actuator**

5 The pitch actuator **60** is attached between the connecting member **62** and the  
6 support structure **30** as best shown in Figures 1 through 7 of the drawings. The pitch  
7 actuator **60** preferably is positioned within the support structure **30** as shown in Figures  
8 4 and 5 of the drawings, however the pitch actuator **60** may be positioned external of  
9 the support structure **30**.

10

11 The extension/retraction of the pitch actuator **60** causes the first yaw actuator  
12 **70** and the second yaw actuator **70** to extend/retract accordingly in a relatively  
13 horizontal manner as shown in Figures 6 and 7 of the drawings. The actuators **60, 70,**  
14 **72** may be comprised of various actuator structures such as but not limited hydraulic,  
15 electric and the like.

16

17 **G. Control System**

18 A control unit **40** is in communication with the first yaw actuator **70**, the second  
19 yaw actuator **70** and the pitch actuator **60** for controlling the same as shown in Figure 9  
20 of the drawings. The control unit **40** determines which actuators **60, 70, 72** should be  
21 extended/retracted according to the controls manipulated by the operator of the  
22 vehicle. The control unit **40** is a valve unit when utilized with a hydraulic system **50**  
23 for controlling the flow of hydraulic fluid to the actuators.

24

25 **H. Operation**

26 In operation, the control unit **40** determines whether a pitch forward condition  
27 exists or a pitch rearward condition exists as shown in Figure 8 of the drawings. If a  
28 pitch forward condition exists, the control unit **40** causes the pitch actuator **60** to  
29 extend thereby causing the yaw actuators **70, 72** to simultaneously extend forwardly

1 (within directly extending the yaw actuators 70, 72) thereby causing the implement  
2 structure 12 to pitch forwardly as best illustrated in Figures 3, 5 and 7 of the drawings.

3

4 If the pitch rearward condition exists, the control unit 40 causes the pitch  
5 actuator 60 to retract thereby causing the yaw actuators 70, 72 to simultaneously  
6 retract rearwardly (within directly extending the yaw actuators 70, 72) thereby causing  
7 the implement structure 12 to pitch rearwardly as best illustrated in Figures 2, 4 and 6  
8 of the drawings.

9

10 If a yaw condition exists, both of the yaw actuators 70, 72 are activated accordingly  
11 to adjust the yaw of the implement structure 12. For example, if the user desires the blade  
12 to be angled with the left side forward, the control unit 40 would cause the second yaw  
13 actuator 70 to extend and the first yaw actuator 70 to retract (and vice-versa). It can be  
14 appreciated that the adjustment of the pitch and yaw may occur simultaneously or separate.  
15 In addition, the actuators may be independently operated without fluid connection to the  
16 other actuators.

17

18 As to a further discussion of the manner of usage and operation of the present  
19 invention, the same should be apparent from the above description. Accordingly, no  
20 further discussion relating to the manner of usage and operation will be provided.

21

22 With respect to the above description then, it is to be realized that the optimum  
23 dimensional relationships for the parts of the invention, to include variations in size,  
24 materials, shape, form, function and manner of operation, assembly and use, are  
25 deemed to be within the expertise of those skilled in the art, and all equivalent  
26 structural variations and relationships to those illustrated in the drawings and  
27 described in the specification are intended to be encompassed by the present invention.

28

1       Therefore, the foregoing is considered as illustrative only of the principles of  
2   the invention. Further, since numerous modifications and changes will readily occur to  
3   those skilled in the art, it is not desired to limit the invention to the exact construction  
4   and operation shown and described, and accordingly, all suitable modifications and  
5   equivalents may be resorted to, falling within the scope of the invention.

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